EFFECTS OF PLYOMETRIC TRAINING ON SELECTED MOTOR COMPONENTS IN SEMI-PROFESSIONAL KABADDI PLAYERS

Dissertation submitted to

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Chennai

In partial fulfillment of the requirements for the degree of

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(SPORTS)

Reg. No. 271750232

MAY – 2019

COLLEGE OF PHYSIOTHERAPY
SRI RAMAKRISHNA INSTITUTE OF PARAMEDICAL SCIENCES
COIMBATORE – 641044

CERTIFICATE

This is to certify that the dissertation work entitled **"Effects of Plyometric Training on Selected Motor Components in Semi-Professional Kabaddi Players"** was carried out by the candidate bearing the **Register No. 271750232 (MAY 2019)** in College of Physiotherapy, SRIPMS, Coimbatore, affiliated to the Tamil Nadu Dr. M.G.R Medical University, Chennai towards partial fulfillment of the **Master of Physiotherapy (Sports).**

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Place: Coimbatore

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Prof. B. SANKAR MANI, MPT (Sports)., MBA,
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INTERNAL EXAMINER **EXTERNAL EXAMINER**

Place:

Date:

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ABSTRACT

Background:

In Kabaddi, the specific fitness is needed with reference to strength, sprint and agility, which equip the athlete to face the physiological and psychological challenges that come his way in his competitive sports career. Plyometric training can contribute to improvements in vertical jump performance, acceleration, leg strength, muscular power, increased joint awareness and overall proprioception for kabbadi players.

Objective:

To evaluate the effects of Plyometric training on selected motor components in semi-professional Kabaddi players.

Participants and methods:

A total of 30 semi-professional Kabaddi players with an age between 12-20 years were selected by the inclusion criteria were assigned randomly as Group A (n=15) were underwent plyometric training and as Group B (n=15) who did their regular training program. Agility, sprint, explosive power were measured before and after the intervention by agility 't' test, 60m sprint test and sargent jump test respectively.

Results:

The difference between the two groups (A & B) for agility time (sec) (t= -2.44, **p=0.021<0.05**) where mean for Group A is 10.31 (SD=0.67) and that of group B improvement 11.17(SD=1.17), for Sprinting time (sec) (t=-4.59, **p=0.0001<0.05**), the mean for Group A is 8.63 (SD=1.08) and that of group B improvement 10.52 (SD=1.16), for jumping performance (cm) (t=3.97, **p=0.0004<0.05**), mean for Group A is 32.27 (SD=5.77) and that of group B improvement 24.40 (SD=5.03).

Conclusion:

This study confirmed that the plyometric training is effective training on improving Agility, Sprint and Explosive power in semi-professional kabaddi players, Hence, we conclude that the Plyometric training (Group-A) is more effective in improving Agility, Sprint and Explosive power in semi-professional kabaddi players.

Keywords:

Kabbadi players, plyometric training, agility, sprint, explosive power.

Introduction

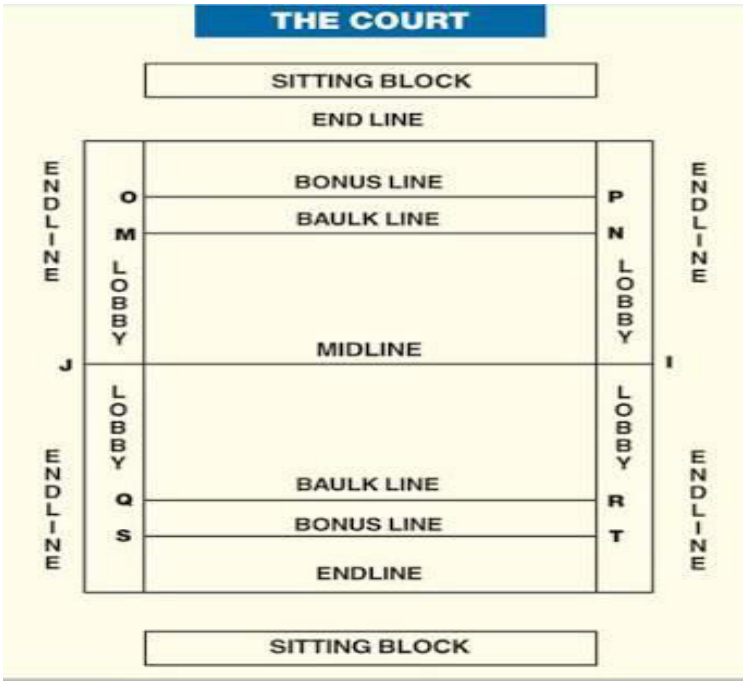
1. INTRODUCTION:

1.1 TOPIC OVERVIEW

Kabaddi is a contact sport that originated in Ancient India, played by thousands of people in cities and villages. The word Kabaddi is derived from a Tamil word Kai - pidi, literally meaning "(let's) Hold Hands", which is indeed the crucial aspect of play. It is the state game of Tamil Nadu, Punjab and Andhra Pradesh in India [1]. In Kabaddi, the specific fitness is needed with reference to strength, sprint and agility, which equip the athlete to face the physiological and psychological challenges that come his way in his competitive sports career. Kabaddi requires tremendous physical stamina, aerobic fitness, anaerobic fitness, dynamic balance, agility, individual proficiency, neuromuscular coordination, lung capacity, quick reflexes, intelligence and presence of mind on the part of both attackers and defenders [2].

Kabbadi needs a small playing area, 14 players (seven on each side) take part and no equipment is required. The dimensions of the playing field are 12.5 x 10m (for adults) divided by a mid-line into two equal halves (each 6.25 x 10 m). The game is supervised by a referee, two umpires and a scorer. The side winning the toss has the option of sending their raiders first, or choosing a particular side. The raider takes the maximum possible inspiration and then moves to the other side of the field, uttering a continuous chant 'Kabaddi' without any further inspiration, try to touch one of the defending players. The defenders try to hold the raider within their area and the raider tries to force his way back to his own side without discontinuing the chant. If the raider is able to come back to his area after touching a defender a point is credited to his group and the person touched is put out of the game [3].

FIG – 1: KABADDI COURT FOR MEN [3].



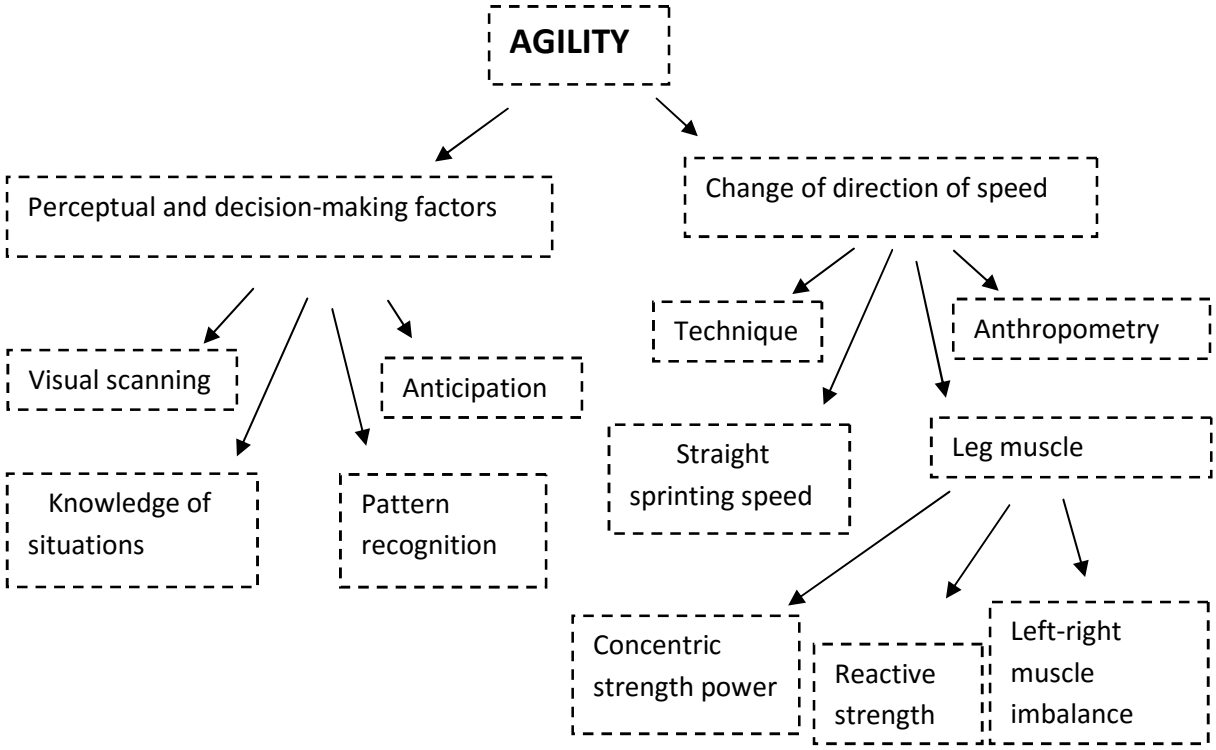
Motor fitness is the ability of the neuromuscular system to perform specific tasks. Fundamental motor skills are common motor activities with specific observable patterns. Most skills used in sports and movement activities are advanced versions of fundamental motor skills. Motor fitness is a more comprehensive term which includes five motor performance components such as power, speed, agility, balance and reaction time, which are important mainly for success in sports [1]. In kabaddi players require motor, physical and physiological components for achieving their goal.

Agility is the ability to change direction rapidly and accurately. The term "quickness" used interchangeably for both agility and change of direction and speed. Quickness has been identified as "a multi-planar or multidirectional skill that combines acceleration, explosiveness and reactive" this definition suggests that quickness consists of cognitive and physical reactive abilities and explosive acceleration [4]. Kabbadi players require agility in executing the movement in faster manner while riding and catching [1].

TABLE - 1: CLASSIFICATIONS OF AGILITY

Agility Classification	Definition
Simple	No spatial or temporal uncertainly
Temporal	Temporal uncertainly, but movement is pre planned (spatial confidence)
Spatial	Spatial uncertainly, but timing of movement is pre planned (temporal confidence)
Universal	Spatial and temporal uncertainty

FIG - 2:UNIVERSAL AGILITY COMPONENTS[4]

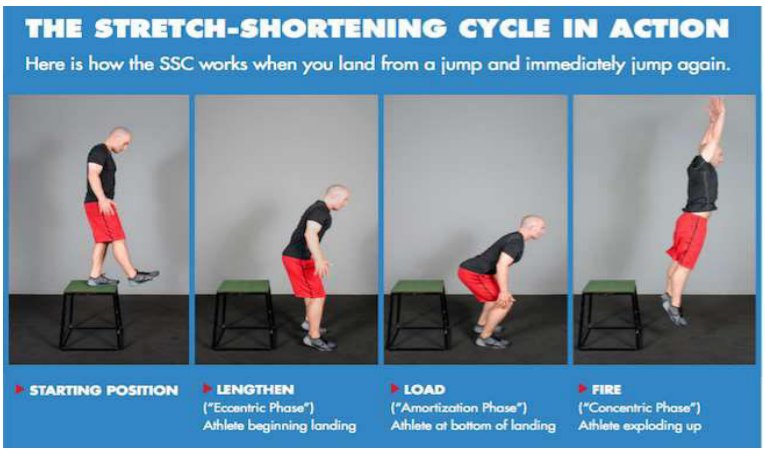


Sprint running contributes in varying degrees to successful performance in many sports. Straight sprinting speed and agility are considered important qualities in many sports. A variety of training regimes are commonly used to improve sprinting performance, including sprint drills, over speed training, sprinting against resistance, weight training, and plyometric training. Kabbadi players require sprint in executing the movement in faster manner while riding and catching [5].

Explosive leg power is a critical component for successful performance in many athletic events. Vertical jumping constitutes an integral component of explosive performance in numerous athletic activities. As such, jumping ability is crucial in the execution of many athletic skills. Jumping is a complex multi-joint action that demands force production and also a high power output [6, 7]. Increasing the degree of coordination and skill in performing the movement and maximizing the ability to use the stretch-shortening cycle in the muscle are other integral factors in vertical jump performance [6]. In kabbadi, the ability to generate maximal strength levels in the shortest period of time (muscle power) has been considered as essential to obtain high sport performance levels [2].

Plyometric training is techniques used by athletes in all types of sports to increase strength and explosiveness. It consists of a rapid stretching of a muscle (eccentric action) immediately followed by a concentric or shortening action of the same muscle and connective tissue [2]. The stored elastic energy within the muscle is used to produce more force that can be provided by a concentric action alone [8].

FIG – 3: STRETCH SHORTENING CYCLE



The fundamental principle of the plyometric method lies in the speed of the shift from and to the eccentric and concentric muscle contractions. "The key to this lies in the time needed for one muscle to shift from a state of flexibility (the stretch) into a state of shortening (the return to its original position). The measurement, the extent of the stretch (the degree), determines the use of the strength that allows flexibility and the transformation of chemical energy into energy used to move muscles" [8].

The muscle elasticity feature and the miotatic reflex (the stretch reflex) place an important role in plyometric method. To obtain a quality eccentric-concentric contraction, three important requirements need to be met:

- The timely activation of the musculature just prior to eccentric contraction,
- The short duration of the eccentric contraction,
- The instantaneous shift between the stretching phase and shortening phase [12].

Plyometric training can contribute to improvements in vertical jump performance, acceleration, leg strength, muscular power, increased joint awareness and overall proprioception for kabbadi players [2].

1.2 NEED FOR THE STUDY:

Kabaddi players require speed, power and agility in executing the movement in faster manner while riding and catching. This clearly shows that players require greater physical fitness and body composition to perform optimally during game [1, 2,6].

Agility, straight sprinting speed and explosive leg power are considered important qualities in many sports [6, 9].

Plyometric exercises are used primarily to increase the maximal power output and jumping ability. Plyometric training programs include training loads with a number of rebounds and intervals between sets of exercises and drills. In plyometric drills, athletes perform stopping, starting and changing directions in an explosive way, which helps to improve agility.

Few studies reported significant positive effects of Plyometric training on bone mass which relative gain ranging from 1% to 8%. Importantly, school-based jump training programmes increase in bone mass in children, improve bone structure and strength and plyometric in early childhood has a persistent long term effects over and above the effects of normal growth and development [11].

More recent observations suggest that plyometric training may also be safe and effective for children and adolescents provides that age appropriate training guidelines are followed [12].Therefore, this study was designed to find out the effect of 8 week plyometric training on selected motor components among young semi-professional Kabaddi players.

1.3 OBJECTIVE OF THE STUDY:

- To evaluate the effects of Plyometric training on selected motor components in semi-professional Kabaddi players.

1.4 RESEARCH QUESTIONS:

- Is plyometric training effective in bringing out changes on selected motor components in Semi-professional Kabaddi players?

1.5 HYPOTHESIS:

1.5.1 NULL HYPOTHESIS:

- There is no significant effect on selected motor components by Plyometric training in Semi-professional Kabaddi players.

1.5.2 ALTERNATIVE HYPOTHESIS:

- There is a significant effect on selected motor components by Plyometric training in Semi-professional Kabaddi players.

Review of Literature

2. REVIEW OF LITERATURE

1. **Hammami et al (2017)** examined the effects on explosive muscular performance by incorporating 8 weeks strength training for the preparation of junior male soccer players. They allocated the subjects into experimental group (n=19), received strength training while control group(n=12) maintained their regular training program. They concluded that 8 week strength training improved the key components of performance among junior soccer players relative to standard in-season training.
2. **Goran Markovic and Pavle Mikulic (2017)** this study did a critically review of the available literature related to lower-body PLY and its effects on human neural and musculoskeletal systems, athletic performance and injury prevention. They also considered studies that combined lower-body PLY with other popular training modalities, as well as studies that applied PLY on non-rigid surfaces. The available evidence suggested that PLY, either alone or in combination with other typical training modalities, elicits numerous positive changes in the neural and musculoskeletal systems, muscle function and athletic performance of healthy individuals.
3. **Ozkan Cimenli et al (2016)** This study investigated the effect of 8 weeks of plyometric training performed on wooden and synthetic surface among 36 male volleyball players jump performance. Participants were randomly divided 3 groups; wooden surface (n:12), synthetic surface (n:12) and control group (n:12). Wooden and synthetic surface experimental training groups performed 3 days a week for 8 weeks. The training program that includes 20 different plyometric exercise drills performed 8 week training period. They concluded that plyometric training on wooden or synthetic surfaces haven't significant differences for improving jumping performance in healthy adult male volleyball players.
4. **Hassan Almoslim (2016)** this study investigated the impact of six weeks of combined plyometric-resistance and combined plyometric-sprint trainings on the fitness elements among 143 male students, aged 18 to 22 years. They were categorized into 3 groups, Plyometric-Sprint Training (PST, n = 48), Plyometric-Resistance Training (PRT, n = 47) and a Control Group (CG, n = 48). The experimental groups trained for 40 min per workout 2 days a week, for 6 weeks. Before and after training, tests were assessed on body composition, speed, power and agility. PRT and PST protocols have effectiveness for acceleration, speed, power and agility. PST showed reduction in agility and an increment in explosive power than PRT, but had same speed.

5. **K. Balasubrananian et al (2014)** this study found the effects of SAQ training and plyometric training on selected physical fitness components of 45 men Kabaddi players. Kabaddi players were divided into three equal groups, group I underwent SAQ training, group II underwent plyometric training and control group. Physical fitness components significantly improved due to SAQ training and plyometric training for men Kabaddi players.
6. **Rodrigo Rami´Rez-Campillo et al (2014)** this study found the effect of a short-term plyometric training program on explosive strength and endurance performance in highly competitive middle- and long-distance runners. Athletes were randomly assigned to a control group (CG, n = 18, 12 men) and an explosive strength training group (TG, n = 18, 10 men). Drop jump (DJ) from 20 (DJ20) and 40 cm (DJ40), countermovement jump with arms (CMJA), 20-m sprint time, and 2.4-km endurance run time test were carried out before and after 6 weeks of explosive strength training. They concluded that properly programmed concurrent explosive strength and endurance training could be advantageous for middle- and long-distance runners in their competitive performance, especially in events characterized by sprinting actions with small time differences at the end of the race.
7. **Hachana Y, Chaabe`ne H, Ben Rajeb G, Khlifa R, Aouadi R, et al. (2014)** this study evaluated the reliability and sensitivity of a ‘‘Modified Illinois change of direction test’’ (MICODT) in ninety-five U-14 soccer players. A total of 95 U-14 soccer players from a professional and semi-professional soccer academy, participated to this study. The intraclass correlation coefficient (ICC) used for relative reliability of the MICODT and its standard error of measurement (SEM) for absolute reliability. They indicated that MICODT presents better ability to detect true changes than Illinois change of direction test (ICODT). The MICODT provided good sensitivity since elite U-14 soccer players were better than non-elite one on MICODT which considered as more suitable protocol for assessing agility performance level than ICODT in U-14 soccer players.
8. **William P. Ebben et al (2014)** This study compared high and low daily volume periodized plyometric training programs and their effect on countermovement jump (CMJ) performance over a 2 week testing time course after training. 35 male subjects participated. Subjects CMJ was tested on a force platform prior to and at 2, 6, 10 and 14 days post training They found that low and high volume periodized plyometric training programs produced equal results. Six to 14 days of recovery post training was required to accrue the training benefit.

9. **EskandarTaheri et al (2014)** this study proved that plyometric and resistance-training exercises were effective in increasing agility and explosive power and reducing sprint time in soccer players. They suggested that Plyometric training had more favorable effects on the study variables compared with resistance exercises.
10. **Yiannis Michailidis et al (2013)** this study determined whether preadolescent boys exhibit plyometric trainability or not among 45 children. They were randomly assigned to either a control participated only in regular soccer practice or a plyometric training group participated in regular soccer practice plus a plyometric exercise protocol). These data indicated that (a) pre-pubertal boys exhibit considerable plyometric trainability, and (b) when soccer practice is supplemented with a PT protocol, it leads to greater performance gains.
11. **Terese L. Chmielewski et al (2013)** in this study the Plyometric exercise was initially utilized to enhance sport performance and used for rehabilitation of injured athletes to help in the preparation for a return to sport participation. They suggested that progression to higher-intensity plyometric exercise is thought to resolve post injury neuromuscular impairments and to prepare the musculoskeletal system for rapid movements and high forces, thus assisting the athlete with a return to full function.
12. **Ahmet Alptekin et al (2013)** this study examined the effects of 8 weeks' plyometric training on active jump, squat jump and 30 m sprint in 13-15-year-old among24 volunteer football players. They assigned them equally to either the control or the training group. The training group carried out a basic training program plus a set of plyometric exercises twice a week for 8 weeks. The control group carried out the basic training program only. This study concluded that plyometric exercise increased active and squat jump but there was no significant effect on 30 m sprint performance.
13. **Mohamed Abd El-Mawgoud-Elsayed (2012**) this study determined the effects of a 8-week plyometric training program on specific physical abilities (legs muscle power, legs muscle strength, back muscles strength, flexibility, speed and level of long jump) and correlation between level of long jump and specific physical abilities. The Results proved that improvements in specific physical abilities and level of long jump can occur in as little as 8 weeks of plyometric training which can be useful during the last preparatory phase before in-season competition for athletes.

14. **Paulo Gil da Costa Mendes de Salles et al (2012)** this study examined the validity and the intra- and inter-evaluators reproducibility of the Sargent Jump Test, as an instrument of explosive strength measurement of soccer players of the sub-15 class. 45 soccer players were randomly selected in the local soccer championship. All subjects performed one test on the same jump platform model Jump test (Hidrofit Ltda, Brazil) and two independent Sargent Jump Tests assessed by the same evaluator. They concluded that the Sargent Jump Test is a valid and reproducible instrument for measuring the explosive strength in homogeneous groups, such as those used in the present study.
15. **Highton JM et al (2012)** this study examined the inter-day and intra-day reliabilities and validities of various sprint performance variables on a non-motorized treadmill (NMT) over distances of 10, 20, and 30 m. This study found that NMT ergometry as a reliable tool for most of the sprint performance variables and revealed that the fastest 30 m overground sprinters were likely to be identifiable via NMT ergometry.
16. **Moeini habestari M et al (2011)**this study investigated the range, incidence, location and mechanism of injury in elite male Kabaddi players. Injury data were collected from 73 elite Iranian Kabaddi players using a questionnaire. The most common injuries were muscular injuries (45.13%), skin injuries (26.96%), bone injuries (14.7%) and joint injuries (13.1%). The majority of injuries were recorded in the upper limb (41.55%), lower limb (32.77%), head and face (15.28%) and trunk and neck (10.3%). These findings demonstrated that the incidence of elite Kabaddi injuries was similar to that reported for rugby players.
17. **Goran Sporis et al (2010)** this study evaluated the reliability and factorial validity of agility tests used in soccer. One hundred fifty volunteer participated in this study. The slalom test (ST) sprint 4 3 5 m (S4 3 5) and sprint 9-3-6-3-6-9 m with 180 turns (S180) tests and T-test (TT) are showed statistically significant differences between the defenders and midfielders (p , 0.05) and between the defenders and attackers (p , 0.05). The results of the this study, showed that the TT proved to be the most appropriate for estimating the agility of defenders, the Sprint with Backward and Forward, and Sprint-180^0 for estimating the agility of midfielders, whereas the S-4 3 5 test can be used for estimating the agility of attackers.

18. **Avery D.Faigenbaum et al (2007)** thisstudy compared the effects of a sixweek training period of combined plyometric and resistancetraining (PRT, n = 13) or resistance training alone (RT, n = 14)on fitness performance in boys (12-15 yr). They suggested that the addition of plyometric training to a resistance training program may be more beneficial than resistance training and static stretching for enhancing selected measures of upper and lower body power in boys.
19. **Olaf Verschuren et al (2007)** this study investigated reliability, construct validity, and feasibility of two sprint tests for children with cerebral palsy (CP). A 26 children with CP participated (7–18 years of age; Gross Motor Function Classification System [GMFCS] levels I or II). On different occasions, the 10_5-Meter Sprint Test and the Muscle Power Sprint Test were scored by different assessors to find out theexcellent inter observer reliability (intra-class correlation [ICC]_1.0 and ICC_0.97) and test-retest reliability (ICC_0.97 and ICC_0.97) were obtained.They concludedboth exercise tests are reliable and havegood feasibility for children and adolescents with CP (GMFCS level I or II). Construct validity is supported for both sprint tests in children classified at GMFCS level I and level II.
20. **Michael G. Miller et al (2006)**, this study showed that 6 week plyometric training can be effective training techniques to improve an athlete's agility and also ground reaction times are decreased with plyometric training.
21. **Raj Kumar & Harish Kumar (2005)** this study investigated the effects of six weeks of two types of plyometric circuit training programmes on jumping performance of female college level players and athletes were compared. Circuit Training Programme-I used depth jumping in combination with hopping and hurdling while Circuit Training Programme-II comprised only of depth jumping from boxes varying in heights from 15-45cms. The proved that gain in jumping abilities as a result of CTP-II are much higher than the gains accruing as a result of CTP-I. The amount of gain in abilities is not uniform. The gain varies from ability to ability. CTP-II has proved more effective in improving the jumping abilities of the subjects because it is more saturated with depth jumping exercises.

22. **Vicky Marginson et al (2005)** this study compared the symptoms of exercise induced muscle damage after an initial and repeated bout of plyometric exercises in men(n=10, age=20-29 years) and boys(n=10, 9-10 years) completed 2 bouts of 8 sets of 10 plyometric jumps. They found that milder symptoms of exercise-induced muscle damage in children include greater flexibility leading to less overextension of sarcomeres during eccentric exercise, fewer fast-twitch muscle fibres, and greater and perhaps more varied habitual physical activity patterns.

23. **Sen and Jayati (2004)**this study conducted to measure the injuries sustained by female Indian kabaddi players. A self-completion questionnaire survey was administered. Out of 231 questionnaires 212 were returned (92% completion rate). Upper extremities (51%) were more vulnerable than lower extremities (46%). Among all body parts, knees (19%) were more injury-prone followed by ankles (14%). In 71% of the cases, the injured players were able to resume training and playing within 1-2 weeks of the injury. This study suggested that the use of protective equipment, more scientific coaching to overcome problems like an unfavourable playing surface, maintenance of physique, as well as giving importance to immediate treatment of any injury (irrespective of severity) would reduce the incidence of injury problems.

24. **Naoto Masamoto et al (2003)** this study explained about acute effects of plyometric exercise on 1 repetition maximum (RM) squat performance in trained male athletes. The data suggested that Depth Jumps performed before 1RM testing may enhance squat performance in trained male athletes. These findings suggest that only high-intensity plyometric exercises can enhance neural stimulation to a level that will significantly increase maximal muscle strength.

25. **Toplica Stojanivic et al (2002)** this study the plyometric training model used for the increase of explosive type strength (the vertical jump), an experimental research was carried out, among 33 volleyball players for eight weeks, during which, two to three training sessions per week were held. The control group trained using technically tactical contents. The results suggested that vertical jump as the fundamental factor for the Experimental group that contributed to the statistically relevant difference in the increase of the vertical jump in comparison to the control group.

26. **Bishop D et al (2001)** this study evaluated the validity of a repeated sprint ability test. They suggested that, while the 5x6 s cycle test is often used to assess RSA ability in a wide range of sports, it may need to be modified to reflect the common sprint distances found in specific sports.
27. **Edwin Rimmer and Gordon Sleivert (2000)** in this study 26 male participants who allocated plyometric group (n=10), the sprint group (n=7) and a control group (n=7). They concluded that a sprint specific plyometric program can improve 40M sprint performance to the same extent as standard sprint training, and possibly by shortening ground contact time.
28. **Ioannis G.Fatouros et al (2000)** this study would compare the effects of 3 different training protocol-Plyometric training, weight training, and their combination- on selected parameters of vertical jump performance and leg strength among 41 men. They were randomly assigned to 1 of 4 groups. This study proved that a combination of a traditional and Olympic-style weight lifting exercises and plyometric drills were useful to improve vertical jumping and explosive performance in general.
29. **Jeffrey A. Potteiger et al (1999)** this study examined the changes in muscle power output and fiber characteristic following 8 week of plyometric training among 19 male subjects. They proved that plyometric training significantly increased power output that may relate to muscle fiber size.

Materials and Methodology

3. MATERIALS AND METHODOLOGY:

3.1 STUDY DESIGN:

This is a pre-test and post test experimental study design.

3.2 STUDY SETTING:

This study was conducted in Government Boys Higher Secondary School play ground, Chinna thadagam, Coimbatore-641108, under the supervision of team trainer and P.E.T trainer. Informed consents were obtained from all the participants.

3.3 SAMPLING METHOD:

Semi-professional Kabaddi players with an age between 12-20 years were selected by simple convenient sampling method.

3.4 SAMPLE SIZE:

A total of 30 semi-professional kabbadi players who fulfilled the inclusion criteria were assigned as Group A (n=15) were underwent plyometric training and as Group B (n=15) who did their regular training program.

3.5 STUDY DURATION:

This study was carried out for 6 months duration.

3.6 TREATMENT DURATION:

The training duration was 8 weeks.

- **Group A Plyometric techniques:**

  Players practiced plyometric for 60 minutes thrice a week for 8 weeks.

- **Group B Control group**

  Players practiced only their regular training program for 60 minutes thrice a week for 8 weeks.

3.7 SELECTION CRITERIA:

3.7.1 INCLUSION CRITERIA:

- Age between 12 to 20 years
- Semi-professional players
- Players interested to participate in training protocol

3.7.2 EXCLUSION CRITERIA:

- Participants involved in any type of plyometric and strength training before
- Players with any lower limb injuries
- Players with history of any chronic diseases.
- Players with history of any congenital deformities
- Player with any respiratory complications

3.8 PROCEDURES:

This study was conducted on 30 Semi-professional kabaddi players and they were selected based on the selection criteria. The purpose and nature of the study were explained to all participants and informed consent wasobtained. All Semi-professional kabaddi players in this study were allocated to two groups. Fifteen players in Group A received plyometric training, while fifteen players in Group B received their regular training program. Agility, Sprint and Explosive power were measured before and after intervention training program.

3.8.1 PLYOMETRIC TRAINING (GROUP A)

a) Warm up: 15 minutes

- Jogging
- Stretching

b) Plyometric training: 30 minutes

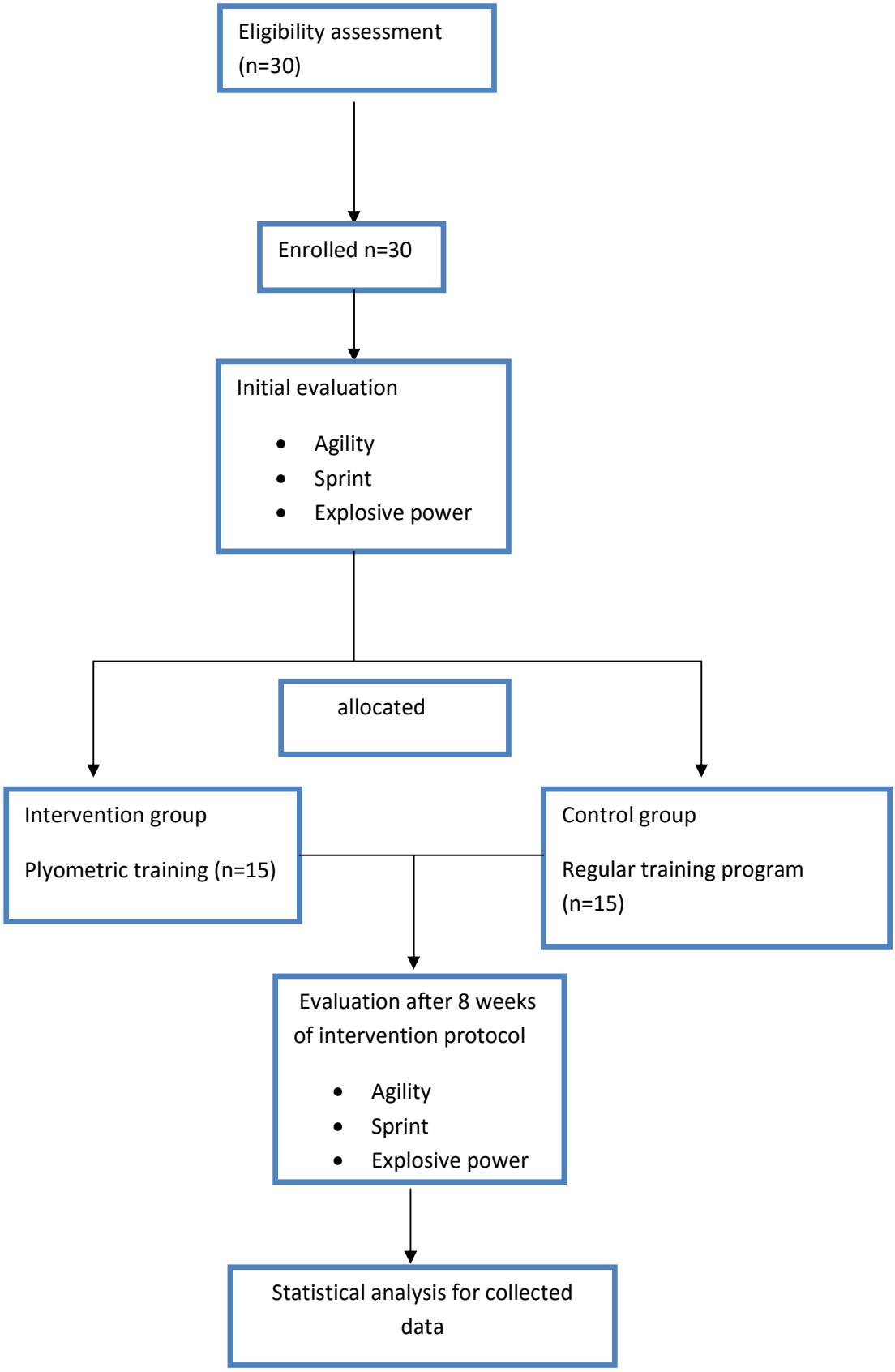
c) Cool down: 15 minutes

- Soft jogging
- Stretching

3.8.2 REGULAR TRAINING PROGRAM (GROUP B)

- Slow jogging – 30 meters
- Sprint running – 30 meters x 2 repetitions
- Duck walking – 30 meters x 2 repetitions
- Duck walk jumping – 30 meters x 2 repetitions
- One leg jumping for both legs – 30 meters
- Forward jumping – 30 meters
- Push-ups – 20 repetitions

3.9 STUDY METHODOLOGY:



3.10 VARIABLES:

3.10.1 INDEPENDENT VARIABLES:

- Plyometric training
- Regular training program

3.10.2 DEPENDENT VARIABLES:

- Selected motor components

3.11 OUTCOME MEASURES:

- Agility
- Sprint
- Explosive power

3.12 MEASUREMENT TOOLS:

3.12.1 Agility "T" test:

The T-Test is a test of agility for athletes that includes forward, lateral and backward running. Set out four cones (5 yards = 4.57 m, 10 yards = 9.14 m). The subject starts at cone A. On the command of the timer, the subject sprints to cone B and touches the base of the cone with their right hand. They then turn left and shuffle sideways to cone C, and also touch its base, this time with their left hand. Then shuffling sideways to the right to cone D and touching the base with the right hand. Then they shuffle back to cone B touching with the left hand, and run backwards to cone A. The stopwatch is stopped as they pass cone A. The trial will not be counted if the subject crosses one foot in front of the other while shuffling, fails to touch the base of the cones, or fails to face forward throughout the test. Take the best time of three successful trials to the nearest 1/10th of seconds.

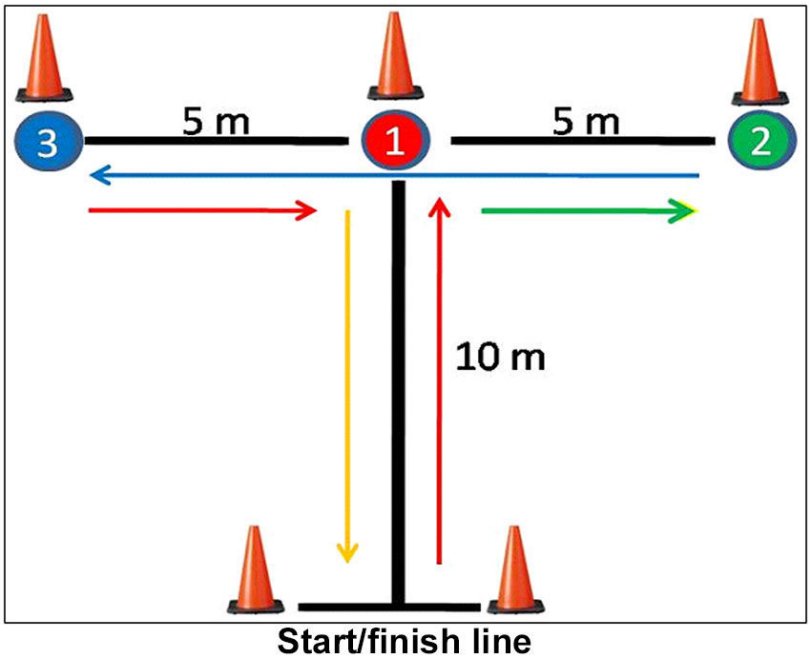


FIG – 4: AGILITY "T" TEST

3.12.2 60-meters sprint test:

The objective of this test is to monitor the development of the athlete's acceleration and pick up to full flight.The test was comprises of 3 x 60m runs from a standing start and with a full recoverybetween each run. The athlete uses the first 30m to build up maximum speed and then maintains the speed throughout 60m. Analysis of the result is by comparing it with the results of previous tests.

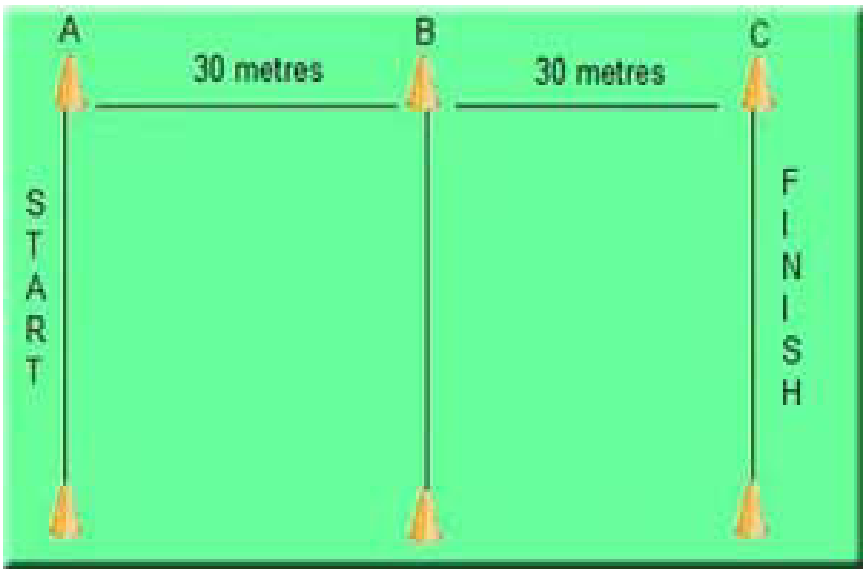


FIG – 5: 60-METERS SPRINT TEST

3.12.3 Sargent jump test:

According to the protocol described by Harman et al. (1991), the subject was positioned with two feet on the platform, followed by a vertical jump, with free movements of the upper limbs and total freedom in joint flexion of the lower limbs. All volunteers jumped three times, with a minimum interval of 45 seconds between the jumps, and the highest value was considered.

FIG – 6: SARGENT JUMP TEST

3.12.4 OTHERS:

a) Cone markers
b) Measuring tape
c) Stop watch
d) Whistle
e) Chalk powder

FIG – 7: MATERIALS USED

3.13 STATISTICAL ANALYSIS:

In this study, the sample data both categorical (nominal) and scale (quantitative) variables. Descriptive statistics have been performed to analyze the sample data. In this study, two hypothetical tests have been concluded to test our hypothesis and those tests are:

i) Paired 't' test

ii) Unpaired 't' test

These two tests are performed at 5% level of significance. That is, α=5% or 0.05

Paired t-test:

Hypothesis:

Null hypothesis, **($H_0=\mu_d=0$)**

(That is, there is no significant mean change in a standard measure between two treatments)

Alternative hypothesis, **($H_0\neq\mu_d=0$)**

(That is, there is significant mean change in a standard measure due to treatment 1 or treatment 2)

Let the level of significance be α=0.05

Test statistic:

In order to test the hypothesis, it is appropriate to use Paired samples t-test and the corresponding test statistic is given below:

$$S = \sqrt{\frac{\sum d^2 - \frac{(\sum d)^2}{n}}{n-1}}$$

$$t = \frac{\bar{d}\sqrt{n}}{S}$$

d = Difference between pre test and post test

$\bar{d}$ = Mean difference

n = Total number of subjects

S = standard deviation

Unpaired t-test:

Hypothesis: Null hypothesis, **($H_0=\mu_1=\mu_2$)**

(That is, there is no significance difference between two groups such as Group A and Group B)

Alternative hypothesis, **($H_1 : \mu_1 \neq \mu_2$)-** Two tailed test

(That is, there is significance between two groups)

Let the level of significance be $\alpha=0.05$

The unpaired t-test was used to compare the effectiveness of two treatments, the difference between pre-test and post test scores would be calculated and then of these differences would be calculated separately for Group A and Group B.

Unpaired t-test:

$$S = \sqrt{\frac{(n_1-1)S_1^2+(n_2-1)S_2^2}{n_1+n_2-2}}$$

$$t = \frac{|\overline{X_1}-\overline{X_2}|}{S\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}}$$

n_1 = Total number of subject in Group – A

n_2 = Total number of subject in Group - B

X_1 = Difference between pre test Vs post test of Group - A

$\overline{X_1}$= Mean difference between pre testVspost test of Group - A

X_2= Difference between pre test Vs post test of Group - B

$\overline{X_2}$ = Mean difference between pre test Vs post test of Group – B

S = Standard deviation.

Data Analysis & Result

4. DATA ANALYSIS

4.1 Intra-Group Analysis:

Intra –Group Analysis for Group A

This study finds the effects of plyometric training (Group A) in improving Agility, Sprint and Explosive power on Semi-professional kabaddi players.

Hypothesis:

Null hypothesis, **($H_0=\mu_d=0$)**

(That is, there is no significant effects of Plyometric training (Group-A) in improving Agility, Sprint and Explosive power on Semi-professional kabaddi players)

Alternative hypothesis, **($H_0\neq\mu_d=0$)**

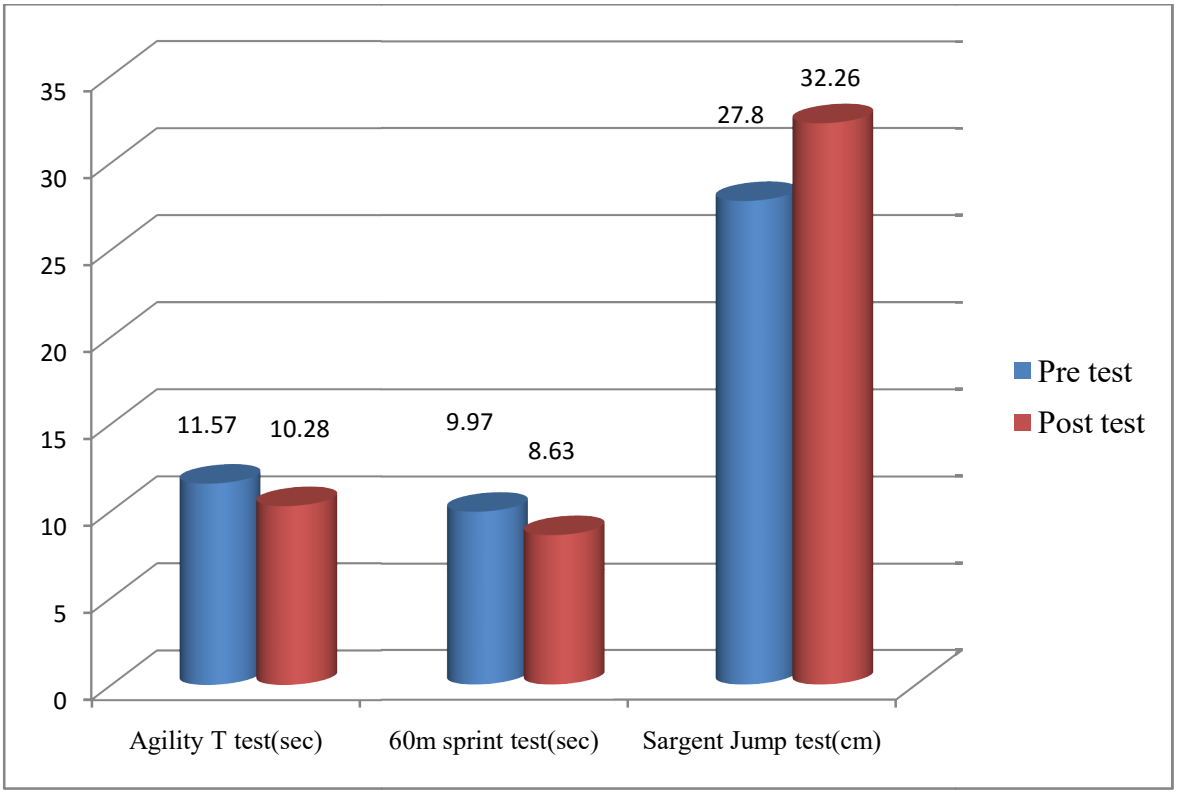
(That is, there is significant effects of Plyometric training (Group-A) in improving Agility, Sprint and Explosive power on Semi-professional kabaddi players)

Let the level of significance be $\alpha=0.05$

Table – 3: Paired‘t’ test for Group A

S. No	Parameters Group-A	Mean		SD		‘t’ value	df	p value
		Pre test	Post test	Pre test	Post test			
1	Agility T test(sec)	11.57	10.31	1.06	0.61	6.34	14	0.0001
2	Sprint test	9.97	8.63	0.98	1.88	11.30	14	0.0001
3	Sargent jump test	27.80	32.26	6.32	-5.78	-10.68	14	0.0001

Graph – 1:Compare the pre and post test score of Group A



The Post test mean value of Agility T test 10.31 (SD=0.67 sec) and pre test mean value of Agility T test 11.57 (SD=1.06 sec), that is the duration (sec) of the test period is improved than pre test mean value.

The Post test mean value of 60m sprint test 8.63 (SD=1.08 sec) and pre test mean value of 60m sprint test 9.97 (SD=0.98 sec), that is the duration (sec) of the test period is improved than pre test mean value.

The Post test mean value of Sargent Jump test 32.26 (SD= -5.77 cm) and pre test mean value of Sargent Jump test 27.80 (SD=6.32 cm), that is the height (cm) of the test period is improved than pre test mean value.

This result suggests that the **"Plyometric training"** is significantly improving the agility sprint and explosive power on semi-professional kabaddi players.

Intra –Group Analysis for Group B

This study finds the effects of Conventional training (Group B) in improving Agility, Sprint and Explosive power on Semi-professional kabaddi players.

Hypothesis:

Null hypothesis, **($H_0=\mu_d=0$)**

(That is, there is no significant effect of Conventional training (Group B) in improving Agility, Sprint and Explosive power on Semi-professional kabaddi players)

Alternative hypothesis, **($H_0\neq\mu_d=0$)**

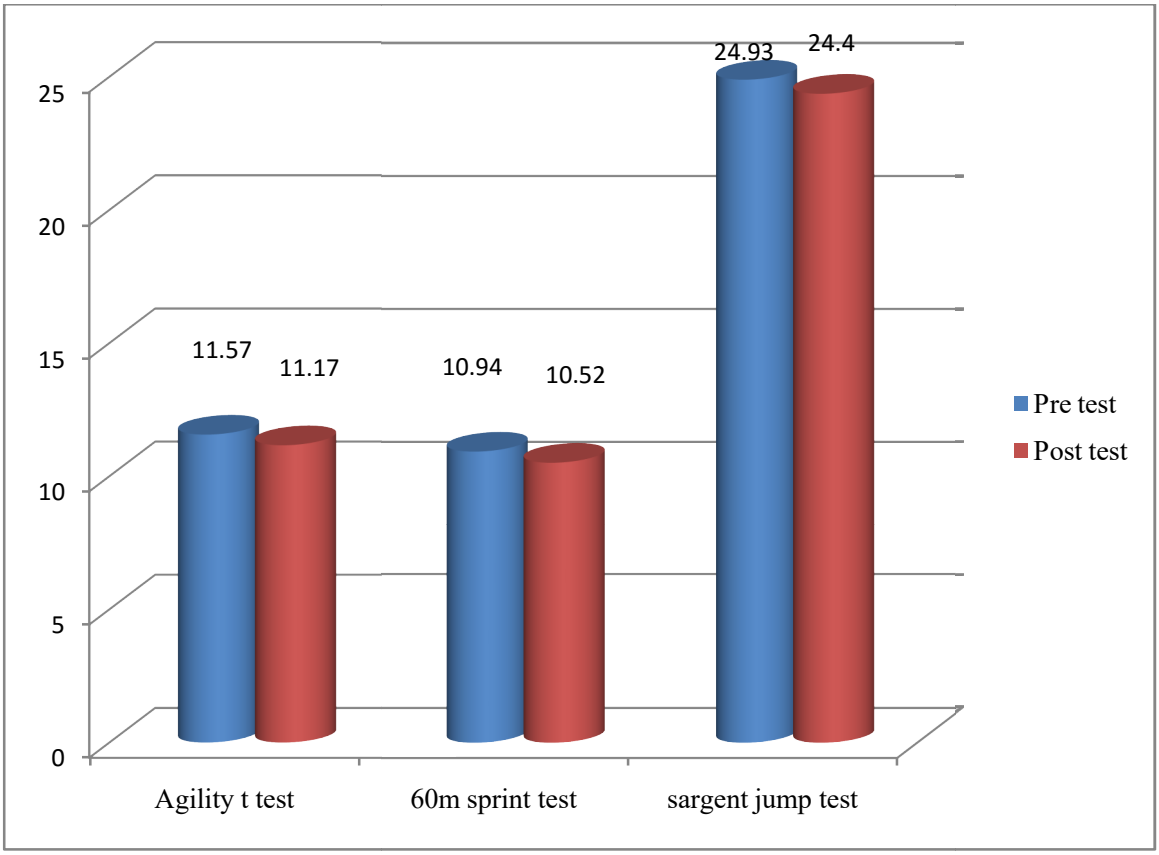
(That is, there is significant effect of Conventional training (Group B) in improving Agility, Sprint and Explosive power on Semi-professional kabaddi players)

Let the level of significance be $\alpha=0.05$

Table – 4: Paired 't' test for Group B

S. No	Parameters Group-B	Mean		SD		't' value	df	p value
		Pre test	Post test	Pre test	Post test			
1	Agility T test(sec)	11.57	11.17	1.12	1.17	4.37	14	0.001
2	Sprint test(sec)	10.94	10.52	1.29	1.16	3.81	14	0.002
3	Sargent jump test(cm)	24.93	24.40	5.04	5.03	1.94	14	0.07

Graph – 2: Compare the pre and post test score of Group B



The Post test mean value of Agility T test 11.57 (SD=1.17 sec) and pre test mean value of Agility T test 11.57 (SD=1.12 sec), that is the duration (sec) of the test period is improved than pre test mean value.

The Post test mean value of 60m sprint test 10.52 (SD=1.16 sec) and pre test mean value of 60m sprint test 10.94 (SD=1.29 sec), that is the duration (sec) of the test period is improved than pre test mean value.

The Post test mean value of Sargent Jump test 24.40 (SD=5.03 cm) and pre test mean value of Sargent Jump test 24.93 (SD=5.04 cm), that is the height (cm) of the test period is improved than pre test mean value.

This result suggests that the **"Conventional training"** is significantly improving the agility sprint and explosive power on semi-professional kabaddi players.

4.2 INTER-GROUP ANALYSIS:

To compare the effects of Plyometric training (Group-A) and conventional techniques (Group-B) in improving Agility, Sprint and Explosive power in Semi-professional kabaddi players.

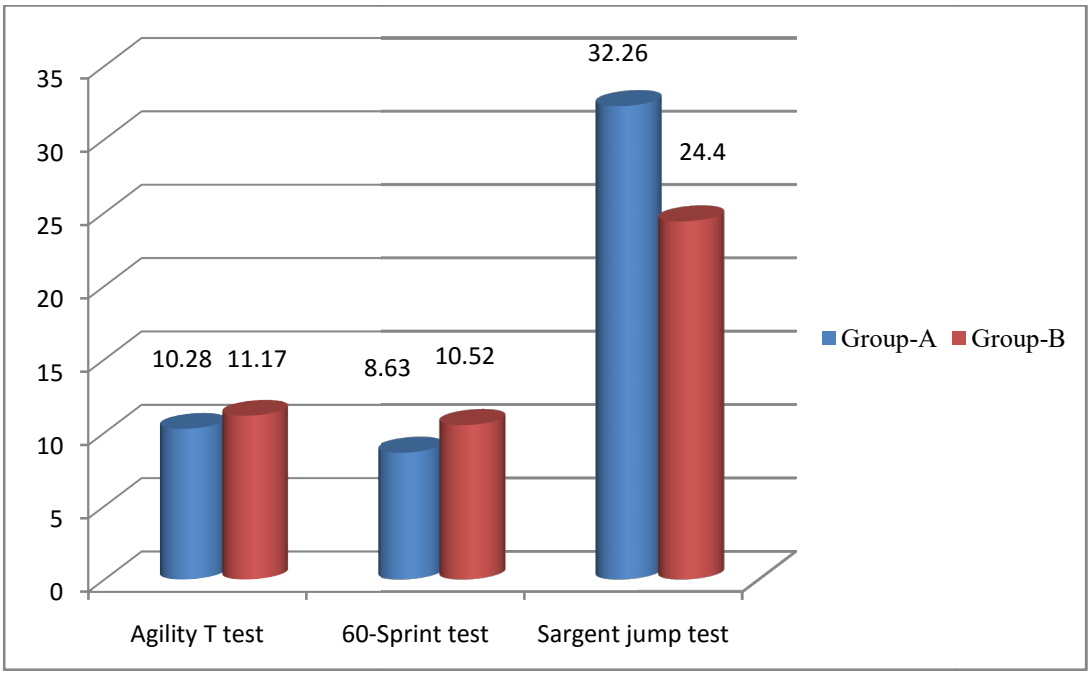
HYPOTHESIS:

Null hypothesis, **(H_0: $\mu_1 = \mu_2$)**
(That is, there is no significant difference between the two training (A and B)
Alternative hypothesis, **(H_1: $\mu_1 \neq \mu_2$)**-Two tailed test
(That is, there is a significant difference between the two training (A and B)
Let the level of significance be α=0.05 or 5%

Table – 5: Comparison post test values of Group A and Group B

Parameters	Mean		SD		't' value	df	p value
	Post test Group-A	Post test Group-B	Post test Group-A	Post test Group-B			
Agility T test	10.31	11.17	0.61	1.17	-2.61	28	0.014
Sprint test	8.63	10.52	1.08	1.16	-4.59	28	0.0001
Sargent jump test	32.26	24.40	5.77	5.03	3.0	28	0.0004

Graph – 3: Comparison post test values of Group A and Group B



The difference between the two groups (A & B) in improving agility time (sec) in semi-professional kabaddi players is extremely statistically significant at 5% level (t= -2.44, **p=0.021>0.05**). The mean improvement in agility test for Group A is 10.31 (SD=0.67) and that of group B improvement 11.17(SD=1.17), which also indicate that improvement in agility by training of Group A.

The difference between the two groups (A & B) in improving Sprinting time (sec) in semi-professional kabaddi players is extremely statistically significant at 5% level (t= -4.59, **p=0.0001<0.05**). The mean improvement in sprinting time for Group A is 8.63 (SD=1.08) and that of group B improvement 24.40 (SD=5.04), which also indicate that improvement in Sprinting by training of Group A.

The difference between the two groups (A & B) in improving jumping performance (cm) in semi-professional kabaddi players is extremely statistically significant at 5% level (t=3.97, **p=0.0004>0.05**). The mean improvement in jumping performance test for Group A is 32.27 (SD=5.78) and that of group B improvement 24.40 (SD=5.03), which also indicate that improvement in Sprinting by training of Group A.

Results:

Going by above results, we see that both the treatment groups A and B are individually effective in improving agility, sprint and explosive power among semi-professional kabbadi players by the Intra-Group Analysis. However, the Inter-Group Analysis shows that there is significant difference between the group-A (plyometric) and group-B (conventional) in terms of all three measures (i.e., agility, sprint and explosive power). Hence, we conclude that **group A-Plyometric training** was effective in improving agility, sprint and explosive power among semi-professional kabbadi players.

Discussion

5. DISCUSSION

Kabaddi is a game which combines the actions of wrestling, judo, rugby and gymnastics. The important body movements in this game involve catching, holding, locking and jumping, thus the possession of desirable anthropometric and physiological characteristics will have a greater advantage in executing a better performance in competition [3]. Kabaddi players also require speed, power and agility in executing the movement in faster manner while riding and catching. [1, 2, 6].

According to **Avery D. Faigenbaum et al**, plyometric training has been proposed as a training mode designed to enhance movement patterns that are used in motor activities such as sprinting and jumping. In plyometric training, the amortization phase between eccentric and concentric movements is shortened, allowing greater power production. By taking advantage of stored elastic energy and the stretch reflex, the muscle is capable of performing more work in the concentric phase. This would allow for improvements in sport performance. The Available evidence suggests that Plyometric training elicits numerous positive changes in neural and musculoskeletal systems, muscle function and athletic performance of healthy individuals. More recent observations suggest that plyometric training may also be safe and effective for children and adolescents provided that age appropriate training guidelines are followed.

This study results proved that 8-weeks plyometric training significantly improved agility, sprint performance and explosive power when compared to regular training program among semi-professional kabbadi player. Consistent with our study, **Edwin Rimmer et al** proved that a sprint-specific plyometric program can improve 40-m sprint performance to the same extent as standard training, possibly by shortening group contact time. **Goran Markovic et al** reported that plyometric, either alone or in combination with other training modalities has potential to enhance a wide range of athletic performance such as jump, sprint, agility and endurance performance in children and young adults of both sexes.**Michael G. Miller et al** proved that 6-weeks plyometric training program effectively improved an athlete's agility.**Ahmet Alptekin et al** concluded that 8 weeks plyometric exercise increased explosive and elastic power.

According to**Khadijeh-Irandoust and Morteza,** plyometric training exploits the Stretch-shortening cycle will be used to produce a more forceful concentric muscle action and increase agility, sprint and explosive power. This improvement could be due to neuromuscular adaptations, such as increased inhibition of antagonist muscles as well as a better activation and contraction of synergistic muscles or increase in muscle fiber size**.**

Several studies have found that the plyometric training significantly improved the sprint **(Markovic et al ; Saez-Saezet al),**agility and coordination which were induced by a neuronal adaptations through selective activation of motors units, synchronization, selective activation of muscles, and increased recruitment of motor units. This mechanism that enhanced the contractile properties of the muscle is more likely to be related either the theory of myosin light chain phosphorylation, or by an increased level of excitation of active motor units.

Plyometric exercises evoke the elastic properties of the muscle fibers and connective tissue in a way that allows muscle to store energy during the deceleration phase and release that energy during the acceleration period. The end result is that muscles are trained under tensions greater than those achieved by conventional slow-speed resistance training. Therefore, plyometric training has been recommended for sports that rely on generation of high power output. Researchers and practitioners assumed that these characteristics of plyometric exercises would facilitate significant gains in muscle strength and power and therefore optimize jumping performance.

Therefore the improvement in selected motor components following plyometric training is most likely due to a combination of enhanced motor unit recruitment patterns and increased muscle fiber cross-sectional area. The improved muscle performance could come from neuromuscular adaptations such as an increased inhibition of antagonist muscles, a better co-contraction of synergistic muscle, an increased activation of synergistic muscles, an inhibition of neural protective mechanisms, and/or an increased motor neuron excitability.

The improvement in power output by the leg muscles could also be due to an increase in muscle fiber size. Improvements in force production have been attributed to increases in muscle fiber size. The fiber hypertrophy that occurred in both the type I and type II fibers in the present investigation likely helped to contribute to the increase in jump height and peak and average power output. This concept is supported by the significant correlations observed between the changes in muscle performance and fiber size.

In contrast, **Ioannis G. Fatouros et al** suggested that itdifferent durations of training periods, different training status of the subjects, or different training designs (i.e., training loads or volumes or exercises) might have caused the discrepancy in the results of previous studies [6].

This result confirmed the effects of plyometric training improving the selected motor components on semi-professional kabaddi players. Hence null hypothesis is rejected and the alternate hypothesis is accepted which stated that, “There is significantly increase in agility, sprint and jumping level for plyometric training in semi-professional athletes”.

Conclusion

6.CONCLUSION

This study shows that both the treatment groups (A & B) are individually effective in improving Agility, Sprint and Explosive power in semi-professional kabaddi players, which was shown by the intra-Group analysis. However, the inter-group analysis shows that there is extremely significant difference between the two training groups (group A> Group B) in terms of all three parameters, (i.e., Agility T test, Sprint test and Sargent jump test). Hence, we conclude that the Plyometric training (Group-A) is more effective in improving Agility, Sprint and Explosive power in semi-professional kabaddi players.

Limitations and Recommendations

7.1 LIMITATIONS:

- Sample size taken in this was small.
- The study was conducted only Semi-professional kabaddi players.
- This study was conducted only for age group between 12-20 years.
- Only male players were recruited in this study.
- Only plyometric training was given for Semi-professional kabaddi players, no other training regimes were given for them.

7.2 RECOMMENTATIONS:

- Study can be done with the larger sample size.
- Study can be done with different age groups.
- Study can be done with female kabaddi players.
- Effectiveness of other training regimes such strength training, resistance training, SAQ training and circuit training can be compared.

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Appendices

APPENDIX: 1

ASSESMENT FORM

Name: Date of assessment:

Age:

Gender:

Address:

HISTORY:

Past medical History:

CONDITIONS	DURATION	CONDITIONS	DURATION
Hypertension		DM	
Cardiac disease		Thyroid problems	
Respiratory conditions		Digestive disorders	
Prolonged hospitalization		Musculoskeletal disorder/injury/Deformity	

Surgical History/Past procedures:

History of procedures	Yes	No
Abdominal surgery		
Spine surgery		
Any implants in both upper and lower limbs		
Others		

Past medical history:

Musculoskeletal problems	Yes/No
Any types of Hernia	Yes/No
Frequent headache	Yes/No
Any others	Yes/No

Personal history:

Smoking history	Yes/No
Drinking alcohol	Yes/No
Sleep problems	Yes/No
Bowel and bladder dysfunction	Yes/No
Under any medications	Yes/No
Any supplements	Yes/No
Habits of regular exercises	Yes/No
Psychological disturbance	Yes/No

Family history:

Hypertension	DM	CAD	Asthma	COPD	Cancer	Others

The anthropometric variables:

Body weight : kg.

Height : cm.

BMI : kg/m^2

Body circumference measurement:

Body circumference (cm)	Right	Left
Arm		
Forearm		
Waist		
Thigh		
Calf		

Physiological variables:

Variables	Values
Resting HR(15 sec. pulse, measured after peacefully sitting for > 10min.) BPM	
Resting blood pressure (measured after sitting peacefully for > 10 min.) mmHg	
Breath holding time (sec)	

Psychological variables:

Variables	Questionnaire/Scale	Score	
		Pre test	Post test
Somatic anxiety	Illinois Competition test		
Cognitive anxiety			
Self confidence			
Sports achievement motivation	Achievement Motivation Test		

Physical variables:

Variables	Test	Pre test	Post test
Agility	Agility T test		
Leg explosive strength	Sargent jump test		
Sprint	60m sprint test		

Appendix: 2

Plyometric training protocol

Weeks	Sessions	Plyometric training program	Set and Repetitions
1	S_1-S_3	Side to side ankle hops (2X15) Standing jump and reach (2X15) Front cone hops (5X6)	3×6
2	S_4-S_6	Side to side ankle hops (2X15) Standing long jump(5X6) Lateral jump over barrier(5X6)	3×6
3	S_7-S_9	Side to side ankle hops (2X12) Standing long jump(4X6) Lateral jump over barrier(2X12) Double leg hops (3X8) Lateral cone hops(2X12)	3×6
4	S_{10}-S_{12}	Diagonal cone hops(4X8) Standing long jump with lateral sprint(4X8) Lateral cone hops(2X12) Single leg bounding(4X7) Lateral jump single leg(4X6)	3×6
5	S_{13}-S_{15}	Diagonal cone hops(2X7) Standing long jump with lateral sprint(4X7) Lateral cone hops(4X7) Cone hops with 180 degree turn(4X7) Single leg bounding(4X7) Lateral jump single leg(4X7)	3×4
6	S_{16}-S_{18}	Diagonal cone hops(2X12) Hexagon drill(2X12) Cone hops with change of direction sprint(4X6) Double leg hops(3X8) Lateral jump single leg(4X6)	3×4
7	S_{19}-S_{21}	Diagonal cone hops(4X6) Hexagon drill(4X7) Cone hops with change of direction sprint(4X7) Double leg hops(2X12) Lateral jump single leg(2X12)	3×3
8	S_{22}-S_{24}	Diagonal cone hops(2X12) Standing long jump with lateral sprint(2X12) Lateral cone hops(4X7) Double leg hops(2X12)	3×3

APPENDIX: 3
CONSENT FORM

I, Mr._____ voluntarily agree to participate in the research study conducted entitled **"Effects of Plyometric Training on Selected Motor Components in Semi-Professional Kabaddi Players"** which is being conducted at Coimbatore.

I understand that the study involves measurement of my explosive, agility, sprint performance through the completion of the intervention protocol.

I acknowledge that:

- I have received an adequate explanation of possible risks and inconveniences that may arise from participation in this study.
- I have received a copy and read fully the written information concerning the study, and any questions have been answered to my satisfaction.
- I understand that all the information I provide will be identified by code only.
- I understand that the information I provide will be kept on secured premises and will be available to the study investigator only except at my request or on my authorization.
- I understand that I am free to withdraw my consent at any time during the study and that the information which has been collected will not be used in this case.

PARTICULARS	NAME	SIGNATURE	DATE	TIME
ATHLETE				
REPRESENTATIVE				
INVESTIGATOR				